

WHAT IS CLAIMED IS:

- 1           1.     A method for coupling a head-end to end-users, comprising:  
2                 providing a mux-node;  
3                 connecting the head-end to the mux-node, the head-end exchanging analog  
4 signals and digital base band signals with the mux-node;  
5                 connecting a plurality of mini-fiber-nodes (mFNs) to the mux-node; and  
6                 connecting the end-users to the mFNs using wired connections.
- 1           2.     The method of claim 1, further comprising:  
2                 receiving a downstream communication signal from the head-end;  
3                 splitting the downstream communication signal into an analog  
4 downstream signal and a digital downstream signal; and  
5                 transmitting the analog downstream signal to the mFNs.
- 1           3.     The method of claim 2, further comprising:  
2                 splitting the analog downstream signal into a plurality of second analog  
3 downstream signals where each of the second analog downstream signals is destined to  
4 one or more of the mFNs; and  
5                 transmitting the second analog downstream signals to respective destined  
6 ones of the mFNs.
- 1           4.     The method of claim 2, further comprising demultiplexing the digital  
2 downstream signal into one or more third downstream signals where each of the third  
3 downstream signals is destined to a subset of the end-users served by one of the mFNs.
- 1           5.     The method of claim 4, wherein the demultiplexing is based on one or  
2 more of a time division multiplexing, frequency division multiplexing, wavelength  
3 division multiplexing, and spatial division multiplexing.
- 1           6.     The method of claim 1, further comprising:  
2                 receiving upstream communication signals from the mFNs;  
3                 separating the upstream communication signals into a first number of  
4 analog signals;  
5                 combining the first number of the analog signals to generate a second  
6 number of analog signals where the first number is greater than the second number; and  
7                 sending the second number of analog signals to the head-end.

1           7.     The method of claim 6, wherein the combining includes one of frequency  
2 stacking or adding the analog signals.

1           8.     The method of claim 6, further comprising:  
2                 separating digital signals from the upstream communication signals; and  
3                 sending the digital signals to a mux/demux/router.

1           9.     The method of claim 8, further comprising:  
2                 separating the digital signals into first signals destined for end-users  
3 serviced by the mux-node and second signals not destined for the end-users serviced by  
4 the mux-node;  
5                 extracting destinations of the first signals; and  
6                 transmitting the first signals to the mFNs corresponding to the  
7 destinations.

1           10.    The method of claim 1, further comprising:  
2                 receiving upstream digital communication signals from the mFNs;  
3                 multiplexing the signals; and  
4                 sending the multiplexed second signals to the head-end.

1           11.    The method of claim 10, wherein the multiplexing is based on time  
2 division multiplexing scheme.

1           12.    A method for coupling a head-end to end-users, comprising:  
2                 providing a primary hub;  
3                 providing a secondary hub coupled to the primary hub;  
4                 connecting a mux-node to the secondary hub using a first number of one  
5 or more first optical fibers; and  
6                 connecting a plurality of mini-fiber nodes (mFNs) to the mux-node using a  
7 second number of second optical fibers, the second number being greater than the first  
8 number.

1           13.    The method of claim 12, further comprising:  
2                 converting in the mux-node first optical signals received from the mFNs to  
3 electrical signals;  
4                 processing the electrical signals;

5                    converting the processed electrical signals to second optical signals; and  
6                    transmitting the second optical signals to the secondary hub.

1            14.    The method of claim 13, wherein a first wavelength tolerance of optical  
2 signals transmitted over the first fibers is more stringent than a second tolerance of optical  
3 wavelength of optical signals transmitted over the second optical fibers.

1            15.    A method for coupling a head-end to end-users, comprising:  
2                    providing a head-end;  
3                    connecting a mux-node to the head-end using first optical fibers spanning  
4 a first distance; and  
5                    connecting mini-fiber nodes (mFNs) to the mux-node using second optical  
6 fibers spanning second distances, the first distance being greater than each of the second  
7 distances.

1            16.    The method of claim 15, wherein each of the second distances is less than  
2 one kilometer.

1            17.    The method for coupling end-users to a head-end, comprising:  
2                    converting in a mux-node first optical signals received from a first  
3 lightwave interface to electrical signals;  
4                    processing the electrical signals;  
5                    converting the processed electrical signals to second optical signals; and  
6                    transmitting via a second lightwave interface the second optical signals to  
7 the head-end.

1            18.    The method of claim 17, wherein a first wavelength tolerance of the first  
2 optical signals received from the first lightwave interface is less stringent than a second  
3 tolerance of optical wavelength of the second optical signals transmitted via the second  
4 lightwave interface to the head-end.

1            19.    A communication system having a head-end and end-users, comprising:  
2                    a mux-node connected to the head-end, the head-end exchanging analog  
3 signals and digital base band signals with the mux-node; and  
4                    a plurality of mini-fiber-nodes (mFNs) connected to the mux-node, the  
5 end-users connected to the mFNs using wired connections.

1           20.     The system of claim 19, wherein the mux-node receives a downstream  
2 communication signal from the head-end, splits the downstream communication signal  
3 into an analog downstream signal and a digital downstream signal and transmits the  
4 analog downstream signal to the mFNs.

1           21.     The system of claim 20, wherein the mux-node splits the analog  
2 downstream signal into a plurality of second analog downstream signals where each of  
3 the second analog downstream signals is destined to one or more of the mFNs, and  
4 transmits the second analog downstream signals to respective destined ones of the mFNs.

1           22.     The system of claim 20, wherein the mux-node demultiplexes the digital  
2 downstream signal into one or more third downstream signals where each of the third  
3 downstream signals is destined to a subset of the end-users served by one of the mFNs.

1           23.     The system of claim 22, wherein the mux-node demultiplexes based on a  
2 time division multiplexing, frequency division multiplexing, wavelength division  
3 multiplexing, and spatial division multiplexing.

1           24.     The system of claim 19, wherein the mux-node receives upstream  
2 communication signals from the mFNs, separates the upstream communication signals  
3 into a first number of analog signals, combines the first number of the analog signals to  
4 generate a second number of analog signals where the first number is greater than the  
5 second number and sends the second number of analog signals to the head-end.

1           25.     The system of claim 24, wherein the mux-node combines based on one of  
2 frequency stacking or adding the analog signals.

1           26.     The system of claim 24, wherein the mux-node separates digital signals  
2 from the upstream communication signals and sends the digital signals to a  
3 mux/demux/router.

1           27.     The system of claim 26, wherein the mux-node separates the digital  
2 signals into first signals destined for end-users serviced by the mux-node and second  
3 signals not destined for the end-users serviced by the mux-node, extracts destinations of  
4 the first signals, and transmits the first signals to the mFNs corresponding to the  
5 destinations.

1           28.    The system of claim 19, wherein mux-node receives digital  
2           communication signals from the mFNs, multiplexes the signals, and sends the  
3           multiplexed signals to the head-end.

1           29.    The system of claim 28, wherein the multiplexing is based on time  
2           division multiplexing scheme.

1           30.    A communication system that includes a head-end and end-users,  
2           comprising:

3                   a primary hub;

4                   a secondary hub coupled to the primary hub; and

5                   a mux-node connected to the secondary hub using a first number of one or  
6           more first optical fibers; and

7                   a plurality of mini-fiber nodes (mFNs) connected to the mux-node using a  
8           second number of second optical fibers, the second number being greater than the first  
9           number.

1           31.    The system of claim 30, wherein the mux-node converts optical signals  
2           received from the mFNs to electrical signals, processes the electrical signals, converts the  
3           processed electrical signals to optical signals, and transmits the optical signals to the  
4           secondary hub.

1           32.    The system of claim 31, wherein a first wavelength tolerance of optical  
2           signals transmitted over the first optical fibers is more stringent than a second tolerance of  
3           optical wavelength of optical signals transmitted over the second optical fibers.

1           33.    A communication system that includes a head-end and end-users,  
2           comprising:

3                   a head-end;

4                   a mux-node connected to the head-end using first optical fibers spanning a  
5           first distance; and

6                   mini-fiber nodes (mFNs) connected to the mux-node using second optical  
7           fibers spanning second distances, the first distance being greater than each of the second  
8           distances.

1           34.    The system of claim 33, wherein each of the second distances is less than  
2           one kilometer.

1           35.    A mux-node that couples end-users to a head-end, comprising:  
2                   a first lightwave interface; and  
3                   a second lightwave interface, the mux-node converts in a mux-node first  
4   optical signals received from a first lightwave interface to electrical signals, processes the  
5   electrical signals, converts the processed electrical signals to second optical signals, and  
6   transmits via a second lightwave interface the second optical signals to the head-end.

1           36.    The mux-node of claim 35, wherein a first wavelength tolerance of the  
2   first optical signals received from the first lightwave interface is less stringent than a  
3   second tolerance of optical wavelength of the second optical signals transmitted via the  
4   second lightwave interface to the head-end.